Criteria for intensive care unit admission and severity of illness

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Abstract

Intensive care is a specialist area of the hospital with concentration of resources and expertise to look after critically unwell patients. No set criteria exist for admission to intensive care, although patients usually have severe illness associated with physiological dysfunction and actual or impending organ failure. There are multiple scoring systems designed to assess severity of illness, all with significant limitations. The National Early Warning Score 2 (NEWS-2) is a commonly used 'track and trigger' system designed to detect and respond to the unwell or deteriorating patient. NEWS-2 is marker of physiological disturbance and high scores correlate with intensive care admission and mortality. Looking at the elective and emergency surgical population, patients at high risk of complications should be admitted to intensive care postoperatively. Increasing age, comorbidities, poor exercise tolerance and major surgical intervention are associated with adverse outcomes. Admission to intensive care often requires difficult time-critical decisions to be made with limited information. Intensive care admission can be the difference between life and death, but there are both physical and psychological harm associated with invasive organ support. The four pillars of medical ethics: autonomy, beneficence, non-maleficence and justice can be used to guide these decisions.

Keywords APACHE; critical care ethics; critical care scoring systems; early warning scores; ICNARC; Intensive Care Society; levels of critical care; outreach; standardized mortality ratio

What is intensive care?

Intensive care units are specialist areas within hospitals with a concentration of expertise and resources for the management of critically ill patients. These resources include provision of organ support, expertise in management of critical illness and close monitoring of physiological variables. On an intensive care unit there is a high level of senior input and high staff-to-patient ratios. Consultant work patterns aim to deliver continuity of care with consultant/patient ratios not exceeding 1:15 and doctor/patient ratio not exceeding 1:8.[1] Twice daily, consultant-led ward rounds are required by UK national guidance, including weekends and national holidays. As a result, intensive care is an expensive and high-demand resource — as of April 2021 there were 4443 beds in the UK with occupancy rates often above 90%.[2] The high demand on intensive care is shown by the cancellation of elective surgical procedures and in December 2019 alone, 330 urgent procedures were cancelled due to lack of available intensive care bed.

The critical care needs of a patient shown in Table 1 can be described using 'levels of care' from 0 to 3. Level 0 and 1 patients are cared for on the ward in the acute hospital setting, with level 1 patients defined by a higher risk of deterioration or a recent discharge from intensive care. Level 2 and 3 patients are treated in the intensive care environment. Level 2 care patients require support for single organ failure or increased monitoring, for example after high-risk surgery. Level 3 patients require either invasive ventilation or basic respiratory support along with support of at least two organ systems. Common forms of organ support include advanced airway management (endotracheal intubation or tracheostomy), respiratory support (invasive or non-invasive ventilation), vasoactive infusions for shock and renal replacement therapy. Patients on intensive care frequently have invasive monitoring including arterial, venous and urethral catheterization.

There is an expansion of enhanced care (also described as level 1.5) provision in hospitals where higher levels of care can be delivered in areas outside of critical care.[3] Examples include postoperative care, maternity, respiratory and cardiac enhanced care areas, which are designed to provide care between the level of the ward and high dependency. Appropriate targeting of 'enhanced care' to patients with increased care needs provides higher quality care on wards whilst preserving critical care capacity. For example, a high-risk surgical patient may benefit post-operatively from increasing monitoring of physiological variables and higher staffing ratios in an enhanced care setting — despite not requiring critical care for invasive organ support.

Why are patients admitted to intensive care?

There is a broad spectrum of disease necessitating intensive care admission including: acute medical illness, exacerbation of chronic illnesses or for postoperative care following major surgery. There are no specific admission criteria due to the heterogeneous range of diseases requiring management in intensive care; however, physiological derangement and organ dysfunction are often the key hallmarks. Common presentations to intensive care include:

- sepsis with shock or respiratory failure
- cardiac emergencies including acute coronary syndrome, heart failure, arrhythmias and post-cardiac arrest syndrome
- respiratory failure due to acute illness or exacerbation of chronic lung disease
- acute renal failure
- endocrine emergencies including electrolyte, hormonal and acid–base disturbance
- acute liver failure
- neurological emergencies with reduced consciousness or respiratory failure

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Critical care needs of a patient

Level	Description	Examples
0	Patients whose needs may be safely delivered on a ward within an acute hospital	• Fluid and antibiotic therapy • 2–4 hourly observations
1	Patients at risk of deterioration or who have recently been discharged from higher levels of care who may be safely cared for on an acute ward with additional input from critical care	• Risk of clinical deterioration • Epidural or regional anaesthesia techniques which require specific monitoring • Tracheostomy in situ without respiratory support • Continuous ECG monitoring with central telemetry and recording
2	Patients requiring closer monitoring or intervention including support for a single failing organ system, or enhanced postoperative care, or those 'stepping down' from higher levels of care	• Basic respiratory support, e.g. continuous positive airway pressure, non-invasive ventilation • High flow (>30 L/min) facial or nasal oxygen • Invasive arterial or central venous pressure monitoring • Need for repeated and frequent blood gas monitoring • Single/low dose vasoactive infusions
3	Patients requiring advanced respiratory support alone (i.e. mechanical ventilation) or basic respiratory support with support of at least two organ systems	• Combinations of the treatments above • Frequently, the requirement for continuous renal replacement therapy may only be performed in level three areas due to more favourable staffing ratios • Need for deep sedation (usually by drug infusion) to facilitate procedures, mechanical ventilation or control of epilepsy

Table 1

- massive haemorrhage, for example following major trauma, gastrointestinal bleed or during the peri-partum period.

Postoperative admissions to intensive care

Surgical risk prediction tools can be used to identify both elective and emergency surgical risk, allowing appropriate allocation of resources and patient counselling. For elective surgery, risk assessment can be performed in the preoperative clinic and guides shared decision making on risk vs benefit of undergoing the procedure. Identifying high risk patients can guide intra-operative management and postoperative destination. Undergoing surgical procedures can produce immense physiological strain including bleeding, fluid shifts, metabolic disturbance, inflammatory response and postoperative pain. Elective admission to intensive care after high-risk surgery can help prevent or identify early postoperative complications. In some high-risk surgical specialties (such as cardiac surgery), patients are admitted routinely to intensive care postoperatively. Although there are physiological reasons for intensive care admission (including hypothermia and invasive cardiorespiratory support), this is another example of an area of high-risk surgery where planned intensive care admission can improve outcomes.

The strongest predictors of mortality in the preoperative period are age, increasing comorbidity and complexity of surgery. At least one of these factors is present in 80% of patients who die in the perioperative period.[4] Poor exercise tolerance is associated with mortality and is initially assessed in the patient's history and assessment of ability to carry out activities of daily living. Exercise tolerance can be formally assessed using cardiopulmonary exercise testing (CPET) which provides numerous physiological measurements such as the 'anaerobic threshold' and 'maximum oxygen uptake during exertion' (VO_2max). These are predictors of morbidity and mortality postoperatively and CPET may offer useful risk-stratification for patients undergoing major surgery.[5] Formal scoring tools such as POSSUM, P-POSSUM, NSQIP, SRS and SORT can be used to quantify risk. Data on the accuracy of these tools comes from poor quality data at high risk of bias. However, NICE guidelines state that all of these tools show a fair level of accuracy for mortality, with less concordance for morbidity. Therefore, the recommendation is to use a validated tool and focus on mortality (with less onus on which tool is used).[6]

Emergency surgery has a different risk profile with higher rates of mortality. The average 30-day mortality after emergency laparotomy is 9.2%.[7] Patients are commonly elderly with multiple comorbidities and require surgery for potentially life-threatening illness. There is growing evidence that routine admission directly to intensive care after high-risk surgery reduces the risk of deterioration, unexpected intensive care admission and mortality; this likely represents a combination of continuous monitoring with early recognition and management of cardiopulmonary complications. An example of risk scoring comes from the National Emergency Laparotomy Audit (NELA) which has been running since 2012. NELA was designed to improve outcomes for patients undergoing emergency abdominal surgery. One of the key preoperative interventions recommended by NELA is estimation of risk using a recognized scoring tool, with planned admission to intensive care for patients with a predicted mortality of greater than 5%.

P-POSSUM is commonly used to predict morbidity and mortality and is designed for all types of emergency surgery. However, it tends to overestimate mortality in high-risk patients. Using data from over 60,000 patients, the National Emergency Laparotomy Audit have designed the 'NELA risk calculator' in conjunction with the Royal College of Surgeons; this is more

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accurate than other risk prediction tools in this cohort of patients, taking into account pre-morbid state, physiological disturbance and surgical complexity.[7] High-risk patients are likely to benefit from close physiological monitoring in ICU postoperatively.

Recognizing the critically unwell patient

Deficiencies in recognition and management of the acutely unwell patient are longstanding and have been highlighted over the past 8 years by National Confidential Enquiry into Peri-Operative Deaths (NCEPOD). Technical deficiencies include inadequate management of the compromised airway, failing ventilation and cardiovascular compromise with delays in delivery of oxygen and intravenous fluids. Highlighted human factor deficiencies are failure to recognize the deteriorating patient, lack of knowledge of critical illness and absence of senior supervision. NCEPOD also identified a lack of urgency in the response to the deteriorating patient and poor communication between healthcare professionals.

The National Early Warning Score (NEWS) and more recently NEWS-2 is a nationally recognized, standardized tool with a common language to improve recognition and system response to the acutely unwell or deteriorating patient.[8] Implemented by the Royal College of Physicians in 2012, NEWS uses a number of physiological variables to risk stratify their severity of illness to 'trigger' an appropriate response by a suitably qualified clinician within a specified timeframe. Initially designed for hospital wards, NEWS-2 is now used in the Emergency Department and pre-hospital setting. NEWS-2 was updated to include monitoring of a patient's consciousness level and recording the use of supplemental oxygen. Scores are assigned to the level of physiological dysfunction in each of the following vital signs, with increasing scores associated with greater disease severity, need for intensive care admission and risk of mortality (Figures 1 and 2):

- respiratory rate
- oxygen saturation
- systolic blood pressure
- pulse rate
- level of consciousness or new confusion
- temperature

Scores across each of these domains are summated and enter an algorithm to establish the most appropriate clinical response (Figure 3). NEWS allows a single significantly deranged parameter (e.g. heart rate below 40 beats per minute) to trigger a rapid response, rather than requiring summated values. A large comparative study of nearly 36,000 patients tested the ability of the NEWS to discriminate patients at risk of cardiac arrest, unanticipated ICU admission or death within 24 hours compared to 33 other scoring systems.[9] It found NEWS had greater ability to discriminate for these combined outcomes listed than many other available scores. NEWS-2 performs as well or better than other prognostic tools used for prediction of mortality and intensive care admission for example the 'quick Sequential Organ Failure (qSOFA)' and the systemic inflammatory response syndrome (SIRS) criteria.[10]

Although NEWS has significantly improved the recognition and escalation of deteriorating patients, there are limitations. It is important to interpret the NEWS-2 alongside clinical assessment of the patient, rather than use the score in isolation. For example, a patient with chronic lung disease such as emphysema may have marked physiological derangement, even with minor illness. On the other hand, patients with a low NEWS may be critically unwell. A patient in renal failure with oliguria, metabolic acidosis and hyperkalaemia may initially have a low NEWS but will require admission to intensive care for renal replacement therapy. Not all critically ill patients exhibit physiological deterioration; sudden collapse may be seen in acute myocardial infarction, pulmonary embolus or arrhythmia.

NEWS does not always reflect degree of organ failure — for example, a score of 2 is given to any patients requiring supplemental oxygen. As a result, there is no differentiation between a patient with minor respiratory failure requiring 2 L/min of oxygen and a patient requiring 15 L/min of oxygen via non-rebreather mask. Patients with high NEWS are difficult to manage on the ward and represent a high nursing burden due to frequency of observations and escalation calls. According to NEWS escalation policy, a patient with a NEWS of 7 should be continuously monitored with escalation to a doctor at specialist registrar level. However, provision of resources such as nurses, doctors, monitoring equipment and intensive care capacity is not always adequate to deliver the expected clinical response.

Critical care outreach teams

Critical care outreach teams provide a valuable link between ward level and intensive care, reviewing patients based on clinical concerns of the treating team and those that 'trigger' a high NEWS. This is an important means to identify patients requiring admission to intensive care, prevent intensive care admission by adequately resuscitating patients on the wards and provide continuity of care to patients discharged from intensive care. Outreach teams are generally multidisciplinary and have a crucial role in supporting and educating teams in the management of acutely unwell patients on the ward. By facilitating early decision making in these individuals and discussions with the parent clinical team, patient and family, an individualized escalation plan can be created for the patient.

A number of trials have questioned whether outreach teams offer meaningful improvements in care for patients. Early work failed to demonstrate any significant reduction in cardiac arrests, unplanned ICU admissions or unexpected deaths, and a 2007 Cochrane systematic review concluded there was insufficient evidence to argue the benefit of outreach services.[11] Despite this, the popularity of the outreach model persisted and recommendations for their implementation were made by a significant number of bodies including the Intensive Care Society (2002), National Outreach Form (2003), National Confidential Enquiry into Perioperative Death (2009) and the Critical Care Stakeholder Forum (2005). The international evidence base has continued to grow and a more recent systematic review found moderate-strength evidence for reductions in cardiorespiratory arrest and mortality.[12]

Prediction of outcome on intensive care

Intensive care patients are a heterogenous population with high rates of mortality. Predictive tools estimate mortality of patients based on acute physiological variables on admission; being able

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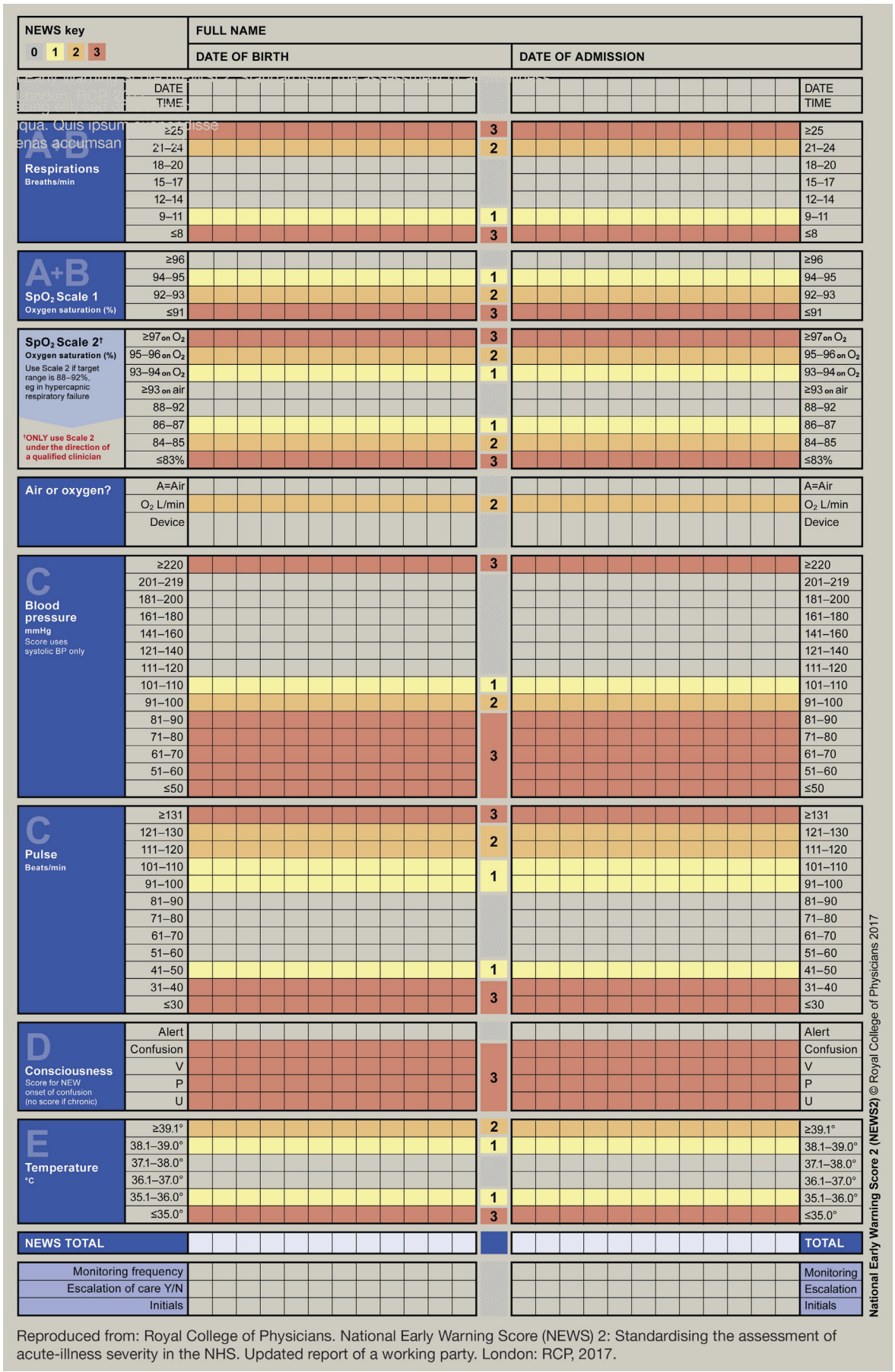

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Figure 1

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The NEWS scoring system

Physiological parameter	Score 3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO_2 Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO_2 Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

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Figure 2

to predict survival on intensive care would allow clinicians to appropriately prognosticate and avoid invasive treatment if likely to be futile reducing patient suffering. Many scoring systems designed to predict mortality after admission to intensive care are in operation in the UK. In the UK, ICNARC and APACHE II are the most commonly used methods — and there may be a role for AI in the future. Although widely used for comparative audit, no scoring system reliably predicts outcome in an individual patient. Scoring systems may produce inaccurate, invalid or non-transferable data for a number of reasons. Firstly, a patient's high severity of physiological disturbance on admission may respond well to resuscitation, whereas some patients will die despite optimum treatment. Scoring systems may fail to incorporate other important factors, for example baseline functional status, biological age, extent of comorbidities and genotype. The underlying disease process causing critical illness is not always taken into account, which is important when considering the clinical trajectory of a patient.

Scoring systems allow comparison of outcomes between critical care units; they do not predict an individual's risk of mortality from critical illness. The Intensive Care National Audit and Research Centre (ICNARC) model was developed to compare risk-adjusted outcomes between ICUs using a large patient cohort: unlike many other scores, it includes diagnostic

NEWS thresholds and triggers

NEW score	Clinical risk	Response
Aggregate score 0–4	Low	Ward-based response
Red score Score of 3 in any individual parameter	Low–medium	Urgent ward-based response*
Aggregate score 5–6	Medium	Key threshold for urgent response*
Aggregate score 7 or more	High	Urgent or emergency response**

* Response by a clinician or team with competence in the assessment and treatment of acutely ill patients and in recognising when the escalation of care to a critical care team is appropriate.

**The response team must also include staff with critical care skills, including airway management.

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Figure 3

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weighting, no exclusions based on specific pathology were made and source of admission was considered. Most units in England, Wales and Northern Ireland contribute to the ICNARC database and its 'case-mix programme', allowing the score to be continually updated.

Admission to intensive care

Deciding which patients can benefit from intensive care admission remains a complex decision which can ultimately mean the difference between life and death. Patients who may benefit from intensive care must have a **reversible illness and a reasonable chance of returning to a good quality of life.** These decisions are often made under significant time constraints in the acute setting and there may be limited information about comorbidities, functional status and personal preference with regards to resuscitation. There is significant uncertainty in outcomes after admission to intensive care and meaningful survivorship after intensive care is difficult to predict. As a result, decisions regarding provision of organ support should be made by senior decision makers with the involvement of multidisciplinary teams.

It is useful to consider the four pillars of ethical medical practice when making decisions around admission to intensive care and provision of organ support. Patient autonomy is key and a patient's individual preference may be to decline intensive care admission based on their own values and beliefs. Beneficence means that offering treatment must offer some benefit to the patient, not just survival through acute illness but returning to an acceptable quality of life. Non-maleficence is important as intensive care admission has the potential to cause significant harm; invasive organ support can cause physical and psycho-logical distress. It is therefore unethical to offer intensive care treatment to patients who are unlikely to survive or return to what that patient values as an acceptable quality of life. Justice requires a utilitarian approach; as a limited resource, intensive care services should be offered to patients most likely to benefit. During the COVID-19 pandemic, NICE guidelines recommended that patients with a 'Clinical Frailty Score' of less than 5 should be considered as good candidates for intensive care admission[13] This is a good illustration of how a 'utilitarian approach' may be applied – however it is important to note that these guidelines were produced in expectation of high demand for intensive care resources and patients with higher frailty scores may still benefit from intensive care admission.

The psychological effect of admission to intensive care and invasive organ support should not be underestimated. A large multi-centre study of 2731 patients who survived critical care admission revealed that there are high rates of mental illness in this cohort of patients 3 months and 12 months after critical care admission.[14] Symptoms of anxiety, depression or post-traumatic stress disorder occurred in half of these patients. This is somewhat unsurprising due to the invasive nature of interventions, confusion, sedation and paralysis, being confronted by mortality, poor sleep and loss of circadian rhythm, loss of control and inability to communicate.

These key ethical issues can be illustrated by looking at the outcomes associated with elderly patients who develop critical illness and are admitted to intensive care. Chin-Yee and colleagues looked at 1671 patients over the age of 80 years admitted to Canadian intensive care units.[15] This study emphasized the high mortality rates associated with critical illness in this age group, with 35% of patients dying during this hospital admission and 41% dying within the next 12 months. Surviving individuals had a low probability of returning to their baseline function (24%). In this group of critically unwell patients, approximately 20% had previously expressed views which would be compatible with a preference for comfort care rather than invasive organ support. Even when patients recover from intensive care admission, they are more likely to suffer ongoing illness with a 32% higher rate of 5-year mortality when compared to a control group.

Conclusion

Deciding which patients may benefit from intensive care admission can be a difficult, nuanced decision. In general, patients with a good functional baseline presenting with an acute reversible illness are likely to benefit from intensive care. The high-risk surgical patient is another subset of patients who may benefit from cardiorespiratory support and increased monitoring postoperatively. Patients with increasing frailty, severe comorbidities and irreversible pathology are not likely to benefit from invasive organ support, but would suffer from the physical and psychological harms associated with these treatments. ◆

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Practice points

- Intensive care is an area of concentrated resources and expertise for management of critically unwell patient. There are no set criteria for admission to intensive care, however admission is associated with illness severity, physiological dysfunction and organ failure
- In response to NCEPOD, National Early Warning Scores were designed to detect and to appropriately manage patients with physiological dysfunction, preventing deterioration. High NEWS is associated with admission to intensive care and mortality
- There is an increased role for 'enhanced care' facilities and critical care outreach which bridge the gap between the ward and intensive care. Concentration of resources in high risk ward areas can improve ward level care for targeted patients and improve access to critical care where required
- The high-risk patient undergoing elective and emergency surgery should be detected using an appropriate risk assessment tool. If predicted mortality is >5%, patients should be admitted to intensive care postoperatively for cardiorespiratory support and intensive monitoring for complications
- There are significant physical and psychological harms associated with intensive care admission. The four pillars of medical ethics - beneficence, non-maleficence, autonomy and justice provides a framework for making difficult medical, ethical and legal decisions around intensive care admission

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